

database, Singapore accounts for 1.1 percent of the world's highly cited papers. This reflects a policy of focusing on and supporting world-class scientists, many of whom have been recruited to Singapore from the United States, the United Kingdom, and elsewhere. Areas of particular strength for Singapore are materials science, engineering, and computer science. Singapore represents an intriguing experiment in emphasizing quality over quantity, and it is already producing good results.

In the early 1980s, the United States was the publication leader in science, with some 40 percent of all articles indexed by Thomson Reuters. By 2008, that number had fallen to 29 percent.

India boosts output. In India, I discussed the proper use of publication and citation data for evaluation with faculty members at the Guru Gobind Singh Indraprastha University. The professors were eager for advice on best practices since it was clear to all that quantitative assessment would increasingly affect decisions about funding and promotion. In many nations—and not limited to Asia—rather crude measures and rewards have sometimes been implemented to improve research productivity. It is imperative that any system of quantitative performance indicators be transparent to all, understandable, and fair. For their own sake, scientists need to educate themselves concerning world standards in research assessment, if for no other reason than to guard themselves against uninformed or bad practices by university or government administrators.

Our national indicators for India have shown a spike in output since 2000, from 2.2 percent of the world's journal literature to 3.4 percent recently. During the last decade, citation impact has also increased in tandem with increased output, which is often not the case (frequently we find that a large increase in output causes citations-per-paper scores to decline). India's research impact stands at some 44 percent below the world average, but it is improving. The strongest areas for Indian science are, as they have been traditionally, the physical and agricultural sciences.

China's remarkable rise. As impressive as the growth of Indian science is, China takes the prize for its astonishing increased output over the last few decades. In the early 1980s, journal articles indexed by Thomson Reuters that carried a Chinese author address were only .4 percent of the world's output. That number is now 10 percent, up from 5 percent only seven years ago. Today, China is second, behind the United States, in its production of research articles published in internationally influential journals in the sciences and social sciences. Like India, the influence of Chinese research is below the world average—about 38 percent below the world average,

but this statistic began to increase in the late 1990s. China also, like India, places an emphasis on the physical sciences: materials science, chemistry, physics, mathematics, and engineering. These fields, along with agricultural sciences and plant and animal sciences, exhibit relatively high impact. Another phenomenon, discernible in the last few years, is an increasing number of hot papers from China. Hot papers are defined as those published in the last two years that rank in the top .1 percent by citations, taking into account their date of publication and field. China now produces more hot papers than Italy, the Netherlands, Japan, Switzerland, Australia, Spain, or Sweden. China is rapidly becoming a world power in research. ■

Assessing Four Budget-Balancing Strategies in Higher Education

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Countries around the world that run educational systems and institutions at all levels face serious challenges in responding to cutbacks in government funding. Thus, it is worth considering whether the options open to public higher education in addressing these challenges correspond with those available to public school systems.

PUBLIC SCHOOL AND HIGHER EDUCATION SYSTEMS

For school systems, government is typically the principal source of revenues for almost all of their budgets. Moreover, new students often are seen as a drain on resources as any growth in students typically is not matched by more public funds. This crisis is especially true during recessions when governments have trouble meeting the many demands on their resources. This explains why public school systems must increase class sizes, cut programs and/or reduce staffing in response to government cutbacks in funding. Public higher education systems and institutions share this characteristic with public school systems.

Yet, in two other critical respects, the economics of public higher education are strikingly different from the pressures that engulf public school systems. One issue is that public higher education has a major revenue source that public school systems do not—tuition fees. This means that increas-

es in enrollments at public colleges and universities will result in more revenues, which may or may not offset the reductions in government funding.

Furthermore, enrollment in higher education is not compulsory, and those trends are far more variable than for public school systems, where the number of students in the short term vary within a relatively small range. Enrollments in public higher education, by contrast, tend to swell during recessions as job prospects are much more limited and more people decide to go back to school rather than stand in the unemployment lines. The question and the challenge for public higher education officials is whether this enrollment growth is viewed as an opportunity or a burden.

COMMON MISUNDERSTANDINGS

These economic realities also lead to conflicts about how public institutions are financed. First, how much institutions spend per student often is regarded as a relatively fixed amount of money. As a result, not enough attention is paid to the effect changes in enrollment can have on per student spending figures. For example, rapid enrollment increases brought about by recessions tend to drive down spending per student as tuition fee revenues do not increase enough to offset the slow-down in government funds.

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The other misunderstanding that clouds the public discourse on cost recovery is that the debate typically focuses on how tuition fees affect demand—namely, the lower the price the more that people will demand to enroll. But the reality is that tuition fees do not just reflect demand. They are also key in defining supply—the lower the fees, the fewer seats can be provided at any given level of government funding. This (over) emphasis on demand considerations contributes to the view that lower fees will result in more access. But the data suggest the opposite: countries that charge higher fees often have greater levels of participation because of the larger number of seats that are made available.

With these economic realities as context, four strategies are available to public higher education officials in dealing with cutbacks in government funding. One of the four—capping enrollments and cutting costs—is revenue neutral or reducing. The other three are revenue increasing—changing the mix of enrollments, increasing tuition fees for existing students, and increasing enrollments while maintaining fees at current levels. It is worth considering the strengths and weaknesses of each approach and their likely effects on the key indicators on quality, access, and productivity.

THE FOUR STRATEGIES

Capping enrollments and cutting costs is public higher education's equivalent of public school systems hunkering down to weather the recession storm. This strategy has the advantage of being budgetarily responsible—that is, making sure the system has enough money to pay its bills. It also holds the best prospect of maintaining quality in the face of cutbacks. Yet, this approach has the tremendous drawback of being politically damaging on key dimensions as it has the painful consequence of reducing access to higher education and cutting higher staff. Given these realities, a principal question is why public higher education officials would engage in this strategy before fully exhausting the possibilities of revenue enhancement.

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Changing the mix of enrollments entails increasing the numbers of international (or out-of-state) students who typically pay much higher fees than resident students. The chief benefit of this strategy is that it usually increases revenues more than the costs of providing the education to these students. It also has the potential to increase the quality of the student body to the extent that the nonresident students are as good as or better than the resident students who otherwise would have been admitted. The main drawbacks of this approach are that it is politically damaging and unfair in that access would be denied to a group of students from families who vote and who paid the taxes that allowed the public institutions to exist and grow. It also does little to improve productivity and may well decrease it in the form of higher spending per student.

Increasing tuition fees for existing students is perhaps the most tried and true response to reduced levels of government support for higher education. It is the most direct and obvious way for institutions to balance their budgets by increasing cost-recovery rates. A further benefit includes being able to maintain quality at current levels or improve them. However, access is likely to be reduced for students who cannot afford the higher prices, especially if not enough financial aid is provided to offset the tuition-fee hikes. It also does little if anything to reduce costs per student or increase productivity.

Increasing enrollments while maintaining current tuition-fee levels often seems to be the least utilized of the four budget-balancing strategies, despite the advantage both of increasing access and improving productivity. Critical questions needed to be addressed in considering whether to utilize this strategy are: Will enrolling more students lead to lower quality? Do current fee levels cover the marginal cost of enrolling more students? Do institutions have the capacity to accommodate additional students?

The answer to these three key questions will differ in the short term (using existing capacity) and the long term (potential for expanding capacity); but if current fees are greater than the marginal cost of enrolling more students, this strategy makes economic sense. The fact that so few systems around the world are choosing this strategy in the face of much more painful choices may mean that officials determined that quality would be compromised and/or marginal costs are higher than current fees. Or it may be that institutional rigidities, lack of a fundamental understanding of marginal costs, or political considerations led to decisions that were unjustifiable on the economics.

Institutional or system officials obviously must decide how to respond to government cutbacks in funds based on their own set of conditions. However, the potential benefits of increasing cost-recovery rates by adding numbers of students rather than, or in addition to, raising tuition fees should be an important consideration in their decision making. ■

Impact of the Financial Crisis on Higher Education in the United States

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The economic crisis of 2008–2009 brought precipitous declines in almost all classes of financial assets and a contraction of economic activity that was, for a time, compared with the Great Depression. Colleges and universities were forced to adjust to a variety of shortfalls in anticipated revenues, but deeper structural changes were virtually impossible. Now, midway into the 2009–2010 academic year, longer-term perspectives, rather than panicky predictions, are possible. In the short term, conditions have not proved to be as bad as feared; but the current crisis has made it far more difficult to address the long-term weaknesses of American higher education.

ENDOWMENT

The wealthiest colleges and universities, normally immune to the tempests besetting other institutions, suffered significant financial damage in this crisis. With all classes of financial assets plunging, their diversified portfolios of alternative investments were hit from all directions. The losses of 2008–2009 will be felt for years to come, and many institu-

tions have announced permanent budget reductions of 10 percent. Cuts of this magnitude can only be achieved by firing people, since salaries comprise roughly three-quarters of university expenditures. Institutions have also instituted hiring freezes and cancelled building plans. Still, these “hardships” should be put in perspective.

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The fall in endowment values had the greatest impact on the wealthiest institutions, since they support a larger share of their budgets with endowment income. Before 2008, these same institutions had experienced the greatest prosperity of their storied histories as a result of the investment booms of the late 1990s and 2003–2007. Their prosperity induced considerable extravagance, especially in amenities for undergraduates. However, these institutions also uphold the highest standards of US science, scholarship, and graduate education. To date, the possible compromise or decline in these areas has not been revealed, although future investments are another matter. Harvard, for example, has placed plans for its new science campus on hold. Stanford will not fill 50 open faculty positions and also halted construction projects. Thus, the research capacity of the nation's most distinguished universities will be frozen for some time.

Still, the immediate picture has brightened somewhat. The stabilization of financial markets, the apparent end of the “official” recession in the United States, and some recovery in US and international financial markets all promise some mitigation of the downturn. Still, selective private colleges and universities have become more dependent on student tuition.

THE STATES AND PUBLIC SUPPORT FOR HIGHER EDUCATION

One higher education official lamented: “every source of revenue coming into the state has decreased.” States, unlike the federal government, must cover their expenditures with revenues, and that has meant rescissions (taking back funds already appropriated) and reductions in higher education appropriations. In six states, rescissions during FY(fiscal year)2009 took back from 8 to 24 percent of state funds. But everyone knew that allocations for FY2010 would be disastrous, although as it turns out, they were not quite that bad. The Obama stimulus package contained over \$50 billion to replace state cuts in education funding, including higher education.

Public universities in many states have faced severe cuts in appropriations. California, with the largest and most admired system of public higher education—and a dysfunctional legis-